Damage to Trees in New York City in the Hurricane of September 14, 1944

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Trees, often of large size, uprooted in the parks, botanic gardens, private estates, and woodland areas, or blown over to an angle quite at variance with their natural geotropic or plagiotropic tendencies, are now a familiar sight to anyone who has lately visited one or more of the five boroughs which comprise Greater New York. And, as everyone knows, these are some of the results of the great hurricane[1] which struck New York City with devastating force on September 14, 1944.

The damage was far more severe than that resulting from the hurricane of September 21, 1938, the main reasons being that in the recent storm the City was more directly in its path; the wind was more violent—81 miles per hour (maximum 99 m.p.h.) as compared with 70 miles per hour in 1938 (maximum 80 m.p.h.); the duration of the storm was longer—about 5 hours as against 4 hours.[2]

It will be recalled that in the 1938 storm one of the most important factors in the overthrow of trees and shrubs was the watersoaked condition of the soil. Because of this, the hold of the roots was weakened. In 1938 the rainfall from September 13 to September 21 (including the hurricane rain) amounted to 8.54 inches—quite a sizable soaking for an eight-day period in these parts.

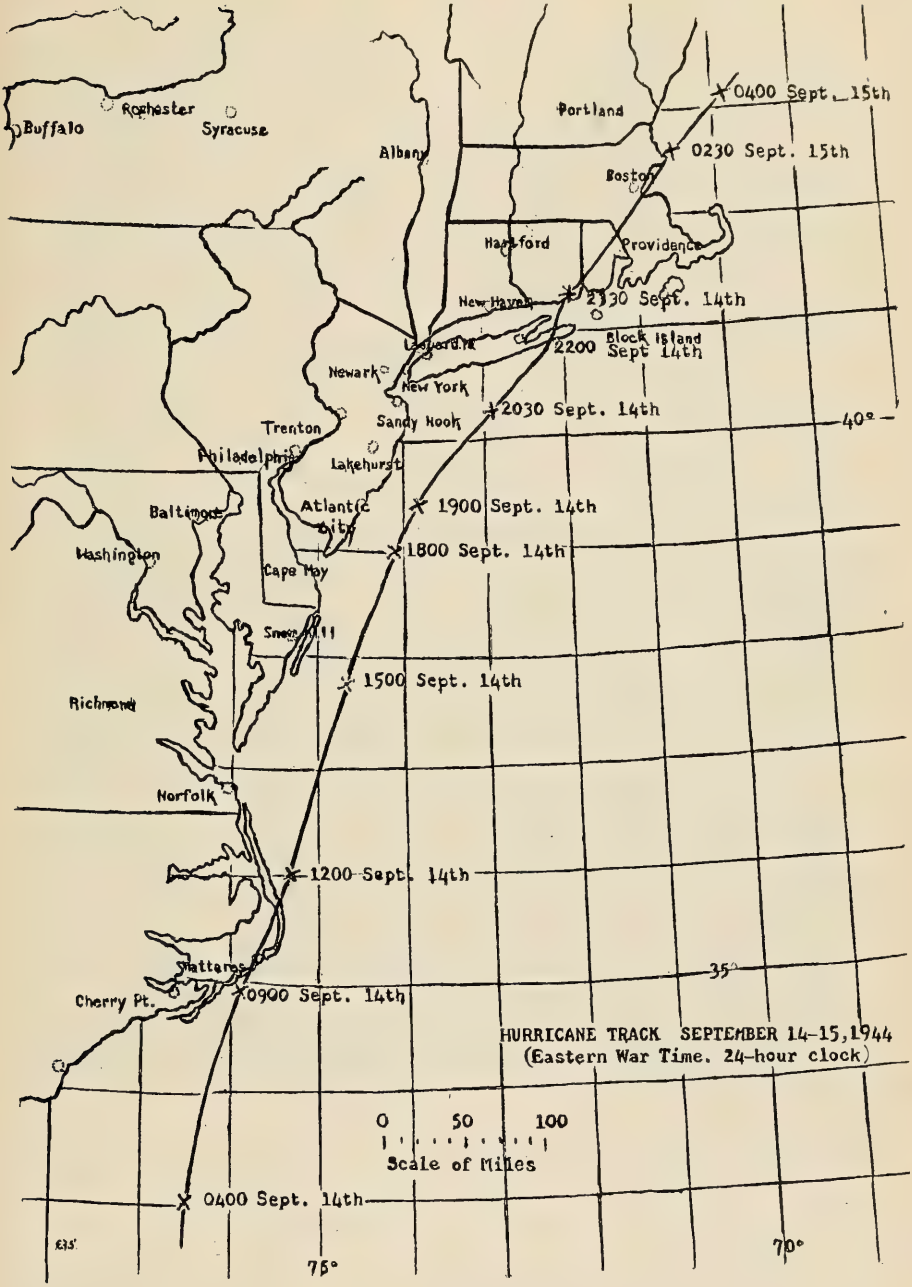
That there was a similar preliminary soaking of the soil in the 1944 storm is borne out by the figures—8.32 inches rainfall from September 1 to and including September 14. However, the soaking in the former period was more gradual, extending over a period of 8 days, while the larger part of the water in the recent storm fell on the 12th, 13th, and 14th—1.86, 3.43 and 2.93 inches

[1] The word "hurricane" originally came from the natives of the West Indies or Central America. It is an Indian word. By early navigators at and following the time of Columbus, the word was variously given as "aracan," "huiranvacan," "urican," "hurican," etc. It is claimed by some to be a Carib Indian word signifying "big wind." According to Professor Lehmann-Nitsche, the god of stormy weather was "Hunrakan" to the Indians of Guatemala, from whom the word hurricane came. From "Hurricanes, their nature and history," by Ivan Ray Tannehill. 5th ed. Princeton Univ. Press. Princeton, N. J. 1944. p. 44.

[2] These figures as well as the following have been kindly furnished me by Mr. Benjamin Parry, Chief of the U. S. Weather Bureau at Whitehall Building, Manhattan, New York City.

Explanation of figure 1

Reproduced, with permission, from "Report of Hurricane, September 14, 1944 (provisional)." Prepared under the direction of Benjamin Parry, Meteorologist in Charge, U. S. Weather Bureau Office, New York, N. Y., October 9, 1944.


Buffalo
Rochester
Syracuse
Albany
Portland
Boston
Hartford
Providence
New Haven
Newark
New York
Trenton
Philadelphia
Lakehurst
Sandy Hook
Atlantic City
Baltimore
Washington
Cape May
Richmond
Norfolk
Hatteras
Cherry Pt.
0400 Sept. 15th
0230 Sept. 15th
2330 Sept. 14th
2200 Sept 14th
Block Island
2030 Sept. 14th
1900 Sept. 14th
1800 Sept. 14th
1500 Sept. 14th
1200 Sept. 14th
0900 Sept. 14th
0400 Sept. 14th
40°
35°
75°
70°
HURRICANE TRACK SEPTEMBER 14-15,1944
(Eastern War Time. 24-hour clock)
0 50 100
Scale of Miles

respectively. Thus the earth was not in quite such a uniformly soaked condition as in 1938.

But the fact that in the 1944 storm the soil was not quite so favorable to uprooting was obviously much more than counter-balanced by the powerful factors above stated—stronger winds, lasting longer, and the position of the New York City area more nearly in the path of the hurricane.

According to present reports, the 1944 hurricane started somewhere in the West Indies, proceeded in a northwesterly direction to the Cape Hatteras region, then curved in a northeasterly direction along the coast, crossing Long Island near Bridgehampton, and entering Connecticut somewhere between New Haven and New London, thence northeastward to the region of Boston, Mass. and finally out to sea (Fig. 1).

At the Brooklyn Botanic Garden, counting all trees and shrubs overthrown or blown over to a leaning position, the number was between 400 and 500, according to Mr. Montague Free, Horticulturist of the Garden. Seventy-five large trees a foot or more in diameter are down, also 150 small trees averaging 6 inches in diameter, and about 200 that need straightening. The Garden has lost many valuable specimens that can not be replaced. This is obvious in the case of the older, larger trees that have been growing 25 years or more. Two fine large specimens of the Golden Larch (*Pseudolarix amabilis*) at the northern end of the Oriental Garden have been lost, also a very valuable tree of Toona (*Cedrela sinensis*) (Fig. 2) a relative of the Cigarbox Cedar, about 40 feet high and 1½ feet in diameter, is gone. The Garden had two of these trees back in 1942, but in the winter of 1942-3 a severe cold spell killed one. A large Oleaster (*Elaeagnus angustifolia*) 1½ feet in diameter, north of the Children's House is gone. In the Wild Flower Garden a fine tulip tree planted in October, 1913, by Adolph Engler, is a total loss, as well as another smaller tulip close to it.

West of the Rose Garden a large *Platanus orientalis* believed to be the only large specimen in this vicinity, is down. In the Elm Family section a large Siberian Elm (*Ulmus pumila*) was broken off squarely, 12 feet from the ground. Three large Black Locusts (*Robinia Pseudoacacia*) (Fig. 3), two of them rare varieties, west of the Lily Pools, and large trees of the Cottonwood (*Populus Eugenei*) and Chinese Poplar (*Populus szechuanica*) near the southern boulder bridge were blown over. One of the large Atlas Cedars (*Cedrus atlantica*) near the west slope of Boulder Hill was blown over but has now been straightened.

Besides such rare individuals, 6 large willow trees, near the brook, two large London Planes on the top of Boulder Hill and a considerable number of poplars in the row east of the experimental plot and the Children's Garden, on the museum embankment and on the west border of the horticultural section are either down or leaning over.

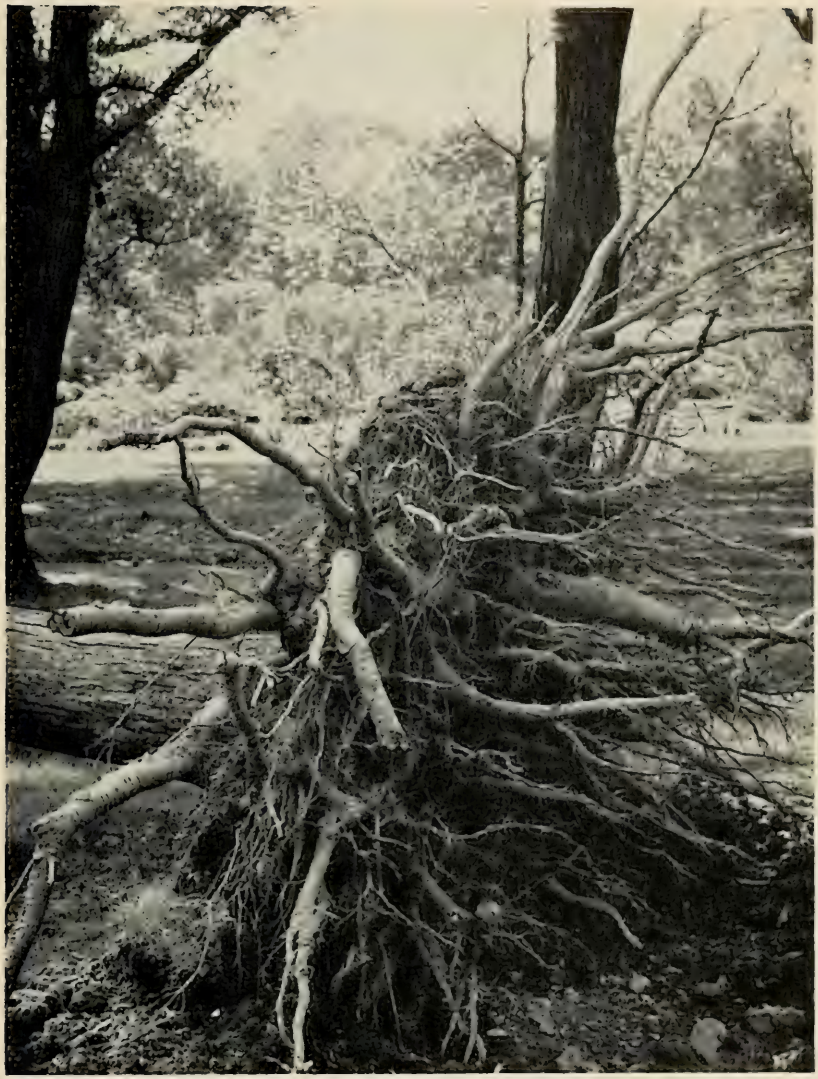


FIG. 2. Toona (*Cedrela sinensis*) Brooklyn Botanic Garden, showing a mass of thick, strong, vertical roots. Photo by Mr. Louis Buhle, Brooklyn Botanic Garden, September 16, 1944.

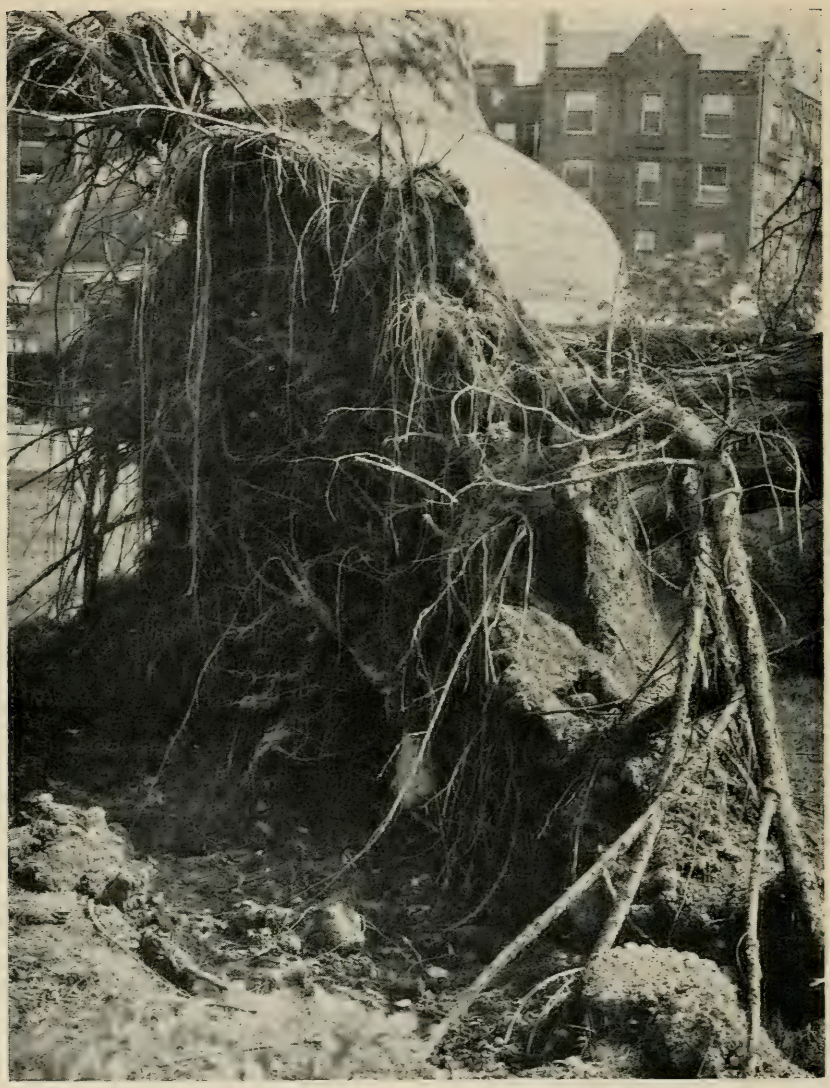


FIG. 3. Black Locust (*Robinia Pseudoacacia*) near Lily Pools and Conservatories, Brooklyn Botanic Garden, showing more or less shallow root system. Photo by Mr. Louis Buhle, Brooklyn Botanic Garden, September 16, 1944.

Outside of the Brooklyn Botanic Garden, Mr. David D. Schweizer, Director of Horticulture of the New York City Park Department, reports that in the whole City, 16,000 street trees are to be removed and 12,000 are to be straightened; while 7,600 park trees are to be removed, and 5,220 are to be straightened. Mr. Carl J. Schiff, Arboriculturist of Brooklyn, reports that 979 trees are down in Prospect Park, and 150 require straightening, and Mr. T. H. Everett, Horticulturist of The New York Botanical Garden, states that 180 large trees are down in that Garden, some of them huge specimens.

Of the Boroughs the worst sufferer was Queens, and next in order came Brooklyn, Bronx, Manhattan and Richmond. Fort Tryon Park did not suffer heavily, but about a half dozen big trees in the region of the Cloisters were lost. Inwood was damaged only slightly, perhaps because of a somewhat protected position. These last two areas, as well as Westchester, were also more remote from the path of the hurricane.

At first we believed that the great losses in the Brooklyn Botanic Garden could be explained from the early history of the Garden. For the land now occupied by the Garden was formerly used by the City for dumping rubbish; hence the subsoil might be expected to contain a stony or coal ash mixture not conducive to the development of deep root systems. We know that in grading for the Rose Garden in 1927 the remains of an old city roadbed were unearthed.[3] However, Prospect Park, which adjoins the Garden, across Flatbush Avenue to the westward, has no such history. As old pictures show,[4] it was formerly open land and woods with farms and an occasional large estate. Yet I found the damage just as severe in Prospect Park as in the Botanic Garden.

Was there any reason why certain trees were uprooted and others remained standing? Possibly a naturally shallow root system was the answer. This is well known to be the case with willows and poplars. But by no means did all uprooted trees have shallow root systems.

After considerable study, following several leads, and visiting various parts of the City, I came to the conclusion that the true solution of the whole problem lies in the fact that there existed *tornadic wind currents* within the hurricane area. If a tree happened to stand in the path of one of these currents the character of its root system mattered little. An example of one such tornadic current can be seen in Prospect Park. In the Park it started at the northwest corner near the Plaza entrance, snapping off a trunk of the rare Yellow-wood (*Cladrastis lutea*) about 12 feet from the ground, and after other minor damage it crossed the road and meadow in a southeasterly direction leaving many fine trees intact on the way, but uprooting a large European Linden and two

[3] However, in talking with old residents, I find that in the old days the Garden land was not as unattractive as it is sometimes pictured.

[4] Sixth Ann. Rept. of Commissioners of Prospect Park, 1866. Map opposite p. 104. Also Seventh Ann. Rept. 1867. Frontispiece, "The Battle Pass in 1866."

small Norway Maples near the east road. Going on southward, it almost avoided the Vale of Kashmir (which is in reality an old "kettlehole" and therefore sunken and protected) but mowed down some Wild Cherry and Sassafras on the western edge; thence to the region south of the rose garden it took an English Elm (*Ulmus procera*), and farther down on the east path it uprooted a giant London Plane, 3½ feet D.B.H. and 90 feet high, a landmark for nearly a century. Coffee Trees (not particularly shallow rooted) a little to the west, and finally, among others, a handsome Silver Linden (*Tilia tomentosa*) just west of the Zoological Garden. But this was by no means the only current. There were many others throughout the park so that the results seemed to have no "rhyme or reason." Truly, as we have often been told, "The wind bloweth where it listeth . . . , but [thou] canst not tell whence it cometh, and whither it goeth." John 3 : 8.

A friend told me that during the 1938 hurricane, in Hartford, Conn., where it was particularly severe, she happened to be looking out of the window while the storm was at its worst. The wind was bending a large Silver Maple almost to the ground. Suddenly a change came and a large branch was snapped off in the *opposite direction.* This illustrates the tornadic or twisting effect[5] of winds within the hurricane.

However, there is no question but that large trees with *shallow root systems,* especially if located in moist soil, might be blown over while nearby trees with deeper roots might be untouched. In such a case the cause would not necessarily be a tornadic wind current, but the continued *force* lasting for hours, of a violent wind. Such a tree I saw in the Kissena Park region, a large Pin Oak (*Quercus palustris*) lying prostrate, its upturned roots revealing its characteristically shallow root system. It had grown near the road skirting the swamp southeast of Kissena Park. Its fellows, *Nyssa sylvatica, Prunus serotina,* and other Pin Oaks, all of *lesser height,* were untouched.

Sometimes it seemed as if certain streets, or perhaps open places between high apartment buildings, especially if they had a north-south, or northwest-southeast direction, formed channels for the wind (which in the N. Y. area came from the north or northwest). Then a tree standing in or at the southern end of such a channel or "canyon" was marked for destruction. Mr. Everett also observed that the *location* of a tree seemed to be more important than the *kind* of tree in determining its survival. For example, not one of the tulip trees on the south side of the Museum Building of The New York Botanical Garden was lost, but north of the building a dozen were down.

Many large London Planes (*Platanus acerifolia*) were uprooted, especially in the parks. I believe that here the enormous butt was a decisive factor. For

[5] Tornado is from Latin *tornare,* to turn. We often on a windy day see miniature tornadoes—small dust whirls traveling along the streets. These illustrate what apparently happens within a large hurricane.

when blown over to an angle, let us say, of 45°, the sheer weight of this butt as well as of the upper parts pulled up the roots or broke them off like a powerful lever and thus completed the destruction which the wind started.

Another point, brought out by several of the City park authorities, is that of resisting leaf surface. Trees with a thick crop of leaves, as in the Norway Maple (*Acer platanoides*), were more subject to windthrow.

Also trees affected with heart rot were ill prepared for the test. Many were snapped off at some distance from the ground—a practical illustration of the function of heartwood—to support the tree.

From the above account it will be clear, I think, that the causes of windthrow in hurricanes are often complex. Each tree presents a problem by itself. In the following table I have summarized the main causes.

Causes of Hurricane Windthrow

I. Shallow Root System
   A. Natural: Poplars, Willows.
   B. Acquired:
      1. Due to shallow soil, underlaid with clay, hardpan, or bedrock.
      2. Due to shallow original planting.

II. Soil Watersoaked and hence offering little resistance to uprooting.

III. Trunks with Heavy Butts, making recovery impossible when blown beyond critical angle. e.g. London Planes.

IV. Large Leaf Surface, offering resistance, e.g. Norway Maples, some Oaks, Ailanthus.

V. Trunks Weakened by heart rot.

VI. Roots Weakened, partially rotted, or cut off in grading operations.

VII. Position of Tree, facing an open exposure as in streets in or at end of "canyon" between houses.

VIII. Position of Tree in Path of Tornadic Current.

I can not end this account without a few words from an entirely different angle. One can not pass a tree day after day for several years and become acquainted with its various moods throughout the seasons without acquiring a sense of companionship—for here is a living being—of another kind of life, it is true—and yet an individual which one knows and loves. And when it is suddenly uprooted, as many fine specimens were last September, one feels a sense of loss, akin to the loss of an old friend. A year or two hence, a stranger visiting our city may think the damage from the hurricane could not have been as bad as described, because the streets and parks will appear quite normal. But certain individual trees, well-known to the passer-by, will be missed for years to come.

Brooklyn Botanic Garden
Brooklyn, New York